THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 27

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SEBASTIANO ACQUAVIVA

Appeal No. 1998-0506
Application 08/314,994[1]

ON BRIEF

Before JERRY SMITH, BARRETT, and FRAHM, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

[1] Application for patent filed September 29, 1994, entitled "Permanent Magnet Electric Motor Having Reduced Cogging Torque," which claims the foreign filing priority under 35 U.S.C. § 119 of Italian patent application TO93A000716, filed September 30, 1993.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claim 1. Claims 2-4 stand objected to as depending upon a rejected base claim. Claims 5-13 are indicated to be allowable over the prior art of record.

We reverse.

BACKGROUND

The invention is directed to a permanent magnet motor having reduced cogging torque by changing the shape and arrangement of the magnets relative to the stator slots.

Claim 1 is reproduced below.

> 1. An improved permanent magnet motor having reduced cogging torque, the improved permanent magnet motor comprising:
>
> a rotor rotatable about a central motor axis and having a plurality of permanent magnet elements disposed at equally spaced intervals, the magnet elements providing an angular distribution of the magnetic polarity about the rotor;
>
> motor windings; and
>
> a stator disposed coaxially with the rotor and separated from the rotor by a circumferential air gap and having a number of slots formed therein for housing the motor windings, the slots facing the air gap, wherein:
>
> the permanent magnet elements are shaped and arranged such that the distribution of the

> density of magnetic energy that is stored in the air gap in the absence of stator slots, as a function of a linear coordinate taken along a circumference disposed within the air gap and coaxial to the motor axis, exhibits an increasing transition in magnitude in a first angular position near a first end of a magnetic polarity and a decreasing transition in magnitude in a second angular position near a second end of the magnetic polarity, the transitions being asymmetrical with respect to each other and the density of magnet energy being substantially constant between consecutive transitions; and
>
> the slots of the stator are disposed in positions such that during operation, if a first slot is in a first angular position corresponding to the first angular position of the increasing transition in magnitude of the distribution of magnetic energy density, a second slot is in a second angular position that corresponds to the second angular position of the decreasing transition in magnitude of the distribution of magnetic energy density, each slot functioning to modify the distribution of the density of magnetic energy in the air gap according to a modulation function which has a local development symmetrical to a radial plane passing through the center of the slot.

The Examiner relies on the following prior art:

De Filippis	5,233,250	August 3, 1993

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being unpatentable over De Filippis.

We refer to the Final Rejection (Paper No. 17) and the Examiner's Answer (Paper No. 25) (pages referred to as "EA__") for a statement of the Examiner's position and to the substitute Appeal Brief (Paper No. 24) (pages referred to as "Br__") for a statement of Appellant's arguments thereagainst.

OPINION

"Anticipation is established only when a single prior art reference discloses, expressly or under principles of inherency, each and every element of a claimed invention." RCA Corp. v. Applied Digital Data Systems, Inc., 730 F.2d 1440, 1444, 221 USPQ 385, 388 (Fed. Cir. 1984).

Appellant argues (Br13):

> [T]he De Filippis reference fails to disclose or suggest utilizing a modulation function to modify the distribution of the density of magnetic energy in an air gap in each slot of the stator to reduce the reluctance torque of a permanent magnet motor. Applicant submits that the De Filippis patent proposes a means for reducing the reluctance torque of the motor by setting the angular extent to be substantially equal to **b** of the pole pitch. In column 4, De Filippis details his solution for reducing the reluctance torque that by setting the angular extent, ", between a minimum value substantially equal to **b** of the pole pitch, J, and a maximum value of **b** of the pole pitch, J, plus ½ of the angular extent, t, of the openings of the recesses in the stator, a reduction in the reluctance torque is realized. Applicant submits that

> this solution as proposed by De Filippis is not equivalent to Applicant's utilizing a modulation function to modify the distribution of the density of magnetic energy in an air gap in each slot of the stator to reduce the reluctance torque.

Appellant's other arguments all deal with De Filippis' failure to teach the use of a "modulation function" to reduce reluctance torque.

The Examiner responds (EA4):

> Applicant's claim fails to set forth the 'modulation function' as a structural limitation of the motor. De Filippis discloses all the structural limitations of Appellant's claim 1. Since all the structural limitations of the motor disclosed by De Filippis are the same as that of Appellant's claim 1, the motor of De Filippis should function in the same manner as Appellant's.

Appellant's argument that De Filippis does not teach utilizing a modulation function to modify the distribution of the density of magnetic energy in the air gap to reduce the reluctance torque (Br13) does not clearly describe the factual issue. The modulation function alone is not responsible for reducing the reluctance torque. It is the claimed alignment of the slots (which have a modulation function) with increasing and decreasing transitions in the magnitude of magnetic energy of the permanent magnet elements that reduces the torque.

The "modulation function" is described in the specification as follows (specification, page 8, lines 4-7, referring to figure 2; see also page 4, lines 30-34): "function of permeance g(x) comprises a modulation function that represents the effects of the reluctance of the slots in the stator on the density of magnetic energy". As far as we can tell, all slots of a stator inherently have a "modulation function" inherently "functioning to modify the distribution of the density of magnetic energy in the air gap" as recited in claim 1. That De Filippis does not mention a "modulation function" does not prevent anticipation under the principles of inherency. It also seems that the uniform stator slots in De Filippis would inherently have a "modulation function which has a local development symmetrical to a radial plane passing through the center of the slot" as recited in claim 1. However, this limitation has not been argued and is not addressed. See 37 CFR § 1.192(c)(8)(iii) (1995) ("For each rejection under 35 U.S.C. 102, the argument shall specify the errors in the rejection and why the rejected claims are patentable under 35 U.S.C. 102, including any specific limitations in

the rejected claims which are not described in the prior art relied upon in the rejection.").

What is important is the relationship between the modulation function g(x) of the slots (figure 2) and the density of magnetic energy f(x) of the magnets (figure 1). The total magnetic energy (the integral of the product f(x) times g(x)) should be independent of the angle of the rotor (specification, page 8). This condition is satisfied when the slots are aligned with increasing and decreasing transitions in the magnitude of magnetic energy of the permanent magnet elements as claimed. It is not clear from the specification where the inflection points x' and x" in the transitions of f(x) in figure 1 occur relative to the physical ends of the magnet, but it can be inferred that they coincide with the ends of the magnet or at the corners as in figure 3. It appears that all permanent magnets would inherently have a density of magnetic energy with increasing and decreasing transitions. The fact that De Filippis does not mention a "distribution of the density of magnetic energy" with an "increasing transition in magnitude" and a

"decreasing transition in magnitude" does not prevent anticipation under the principles of inherency.

The issue is whether De Filippis discloses, expressly or by principles of inherency, slots aligned with increasing and decreasing transitions in the magnitude of magnetic energy of the permanent magnet elements as claimed.

The fact that the slots of the stator in De Filippis inherently have a modulation function and that the magnets inherently have increasing and decreasing transitions in the density of magnetic energy does not mean that the modulation function is used to reduce cogging torque unless the claimed alignment is shown. De Filippis describes that the reluctance torque (cogging torque) can be reduced by selecting the angular extent " for the permanent magnets "between a minimum value substantially equal to **b** of the pole pitch J and a maximum value of **b** of the pole pitch J plus ½ of the angular extent t of the openings of the recesses 4 in the stator" (col. 4, lines 13-16). Appellant argues that this is not equivalent to using a modulation function to reduce cogging torque. We agree. De Filippis only discusses the angular extent of the permanent magnet

and does not disclose the relationship of the slots to the magnet. Figure 3 of De Filippis does not show the slots aligned with the ends of the magnets. Furthermore, because the magnet can have a range of angular extent, one of ordinary skill in the art would not have been taught to use the specific claimed spacing and would not have been put in possession of the invention.

De Filippis also describes reducing the reluctance torque by selecting the plates of the stator of a "size such that the material constituting the plates operates in conditions of maximum magnetic permeability ()" (col. 4, lines 24-26). Appellant argues that this is not equivalent to using a modulation function to reduce cogging torque. We agree. The selection of material has nothing to do with alignment of the slots relative to the magnets.

For the reasons stated above, we find that De Filippis does not anticipate claim 1. The rejection of claim 1 is reversed.

REVERSED

JERRY SMITH Administrative Patent Judge	)	
	)	BOARD OF PATENT
LEE E. BARRETT Administrative Patent Judge	)	APPEALS AND INTERFERENCES
ERIC S. FRAHM Administrative Patent Judge	)	

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